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Snowfall microphysics and polarimetric features of a warm front during the ICE-POP 2018 campaign

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In this study we investigate the microphysics of an intense snowfall event during the ICE-POP 2018 campaign, which took place in South Korea to support the PyeongChang2018 Winter Games. We aim to show how the dynamics and microphysics interacted in this extreme event. An X-band polarimetric scanning radar was deployed in Gangneung at sea level, while a W-band cloud profiler and a Multi-Angle Snowflake Camera (MASC) were installed in PyeongChang at 680 m asl.

On 28 February 2018, 57 mm of equivalent liquid precipitation were measured in 24 hours. It represents 77% of the 2018 winter precipitation in PyeongChang, showing the significance one single event can have on the seasonal precipitation in this region. A potential vorticity streamer led to the intensification of an existing surface cyclone, such that an active warm front reached the PyeongChang region. Doppler radar measurements suggest the presence of a warm conveyor belt (WCB) and a low level jet (LLJ) with altitude and speed that agree with radio-soundings. Profiles of polarimetric radar variables reveal an increase in differential reflectivity (Z_{DR}) at 5500 m altitude just below the WCB. We interpret it as anisotropic growth of crystals by vapor deposition and early aggregation. Hydrometeor classification based on polarimetric data shows an increase in the proportion of rimed particles just below 4800 m where riming sets on. The LLJ is bounded by a shear layer, which separates it from the WCB. In this shear layer a peak in specific differential phase shift (K_{dp}) collocated with a maximum in proportion of rimed particles is observed at 2500 m. We advocate that this peak in K_{dp} is due to secondary ice generation by the Hallet-Mossop process.

This case study reveals the role of the WCB, the LLJ and its associated wind shear in snowfall enhancement by aggregation and riming. This shows the importance of the interactions between dynamics and microphysics in the considered snowfall event.